Province of British Columbia

Ministry of Agriculture and Food

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Agriculture Canada

BRITISH COLUMBIA
TREE FRUIT ORCHARD CONDITION

Study Conducted as Project Number 271322 Sub-project 3

Under

Canada-British Columbia Subsidiary Agreement on

Agriculture and Rural Development

Prepared by:

Dawson, Dau and Associates Ltd.
1551 - 134A Street
White Rock, B.C.
V4A 5P7

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1. INTRODUCTION

Accurate information on the tree fruit production base is critical to any program for the maintenance or enhancement of productivity in the B.C. tree fruit industry.

Low orchard productivity has been identified as a major cause of low profitability in the tree fruit sector (for example, current apple orchard yields equal 19,000 lbs per acre, while trees are capable of bearing 28,000 to 30,000 lbs per acre). A part of this poor productivity has been due to old and poor orchard stands which cannot provide high yields consistent with good quality crops. The last tree census, conducted by B.C. Tree Fruits and B.C.D.A, canvassed every fruit grower in the Okanagan Valley and prcvided information which is summarized in Table 1.1.

TABLE 1.1

NUMBER AND AGE DISTRIBUTION OF TREES BY MAJOR FRUIT TYPE

Fruit	No. Trees	Age Distribution (%) <5 Years	5 - 12 Years	+12 Years
Apples				
Summer	54,820	40	49	11
Winter	1,920,652	30	40	30
Pears	246,764	9	23	68
Cherries	160,994	19	30	51
Peaches	239,365	33	35	32
Apricots	40,782	12	18	70
Prunes	80,767	24	31	45
Plums	5.610	41	39	20
Crabapples	960	--	7	93

Source: Summary and Analysis of the 1973 Tree Census, BCDA & BCTF Ltd., Kelowna, B.C., March, 1974.

In Table 1.1, more than 30% of the trees for each type of fruit (except summer apples and plums) were more than 12 years old. For winter apples, 2% of the Red Delicious and 11% of the McIntosh varieties were more than 25 years old, according to the census information. In 1973, an estimated 60% of the orchard area was on standard rootstock, 27% on semi-standard, 11% on semi-dwarf and 2% on dwarf size trees. It was evident from this data that operators collectively were either reluctant or unable to undertake necessary tree renewal practices in order to maintain productivity within their orchards.

The problems underlying the lack of orchard renovation in 1973 are still in place today. Producers of tree fruit have historically experienced low levels of income, low rates of return to resources, and unstable product prices. These difficulties have created an atmosphere of uncertainty in the industry which has resulted in a lack of investment by growers who remained doubtful of the future viability of their operations. The Hudson Report (S.C. Hudson, An Economic Study of the Tree Fruit Industry in British Columbia, 1973.), indicated that 35% of B.C. producers operated orchards of less than 5 acres, 57% had orchards between 5 and 25 acres and less than 10% of growers operated orchards of more than 25 acres. Of these growers, Hudson estimated that approximately one-third had difficulty covering variable costs of production.

Facing significant economic constraints, it is understandable

that members of the industry were reluctant to undertake orchard renovations which necessitated high initial investments and lower incomes until new plantings came into production. Delays as a result of tree renewal could involve time frames of from 5 to 10 years after planting, depending on the nature of the replacement system introduced.

Orchard renovation to improve returns to resources devoted to orcharding involves many different options for growers:

1. planting different varieties for improved yield and marketability.
2. planting the same variety, but on a new rootstock (ie. different tree size).
3. planting at a different spacing, with either the same or alternate variety (ie. higher density).
4. planting the same variety, using the same spacing, but utilizing a different strain of the same variety (eg. such as a spur strain).
5. planting new trees, the same variety and at the same spacing (ie. an upgrade of the existing system).

There may be other options depending on grower location and management conditions. Under many circumstances, the decision to replace a block of trees may be properly considered as the adoption of an entirely new management system. Adjustments to the production process to increase efficiency using one or a combination of the above options, constitutes a long run structural change to the nature of the orchard. This is true from both a grower and industry perspective.

To planners attempting to assist development of the tree fruit sector, the possibility of orchard renewal raises a number of questions, such as:

a) What part, and how many acres, of the existing orchard land should be replaced?

b) When should replacement occur?

c) What are the likely costs of such a process, and the expected adoption rates for tree renewal by the industry?

d) What type of system should the replacement orchard be? That is, should plantings be high density, medium density, on dwarfing rootstocks, semi-dwarf, etc.

Faced with uncertainties regarding the availability of capital with which to effect any of the above changes and faced with a range of apparently feasible alternatives, growers have been slow to adopt new (high density) technology in fruit growing areas of the province. Similarly, planners at both industry and government levels have not had the information necessary to properly evaluate these options from the standpoint of establishing desirable objectives and the forms of assistance/incentives necessary to achieve those objectives.

Since the last (and only complete) tree census was completed in 1973, no attempt has been made to compile a comprehensive base of information which would provide planners with an overall view of the "state" of commercial orchards. Information has not been gathered in a form which describes the physical characteristics of fruit trees and growing conditions as they exist and change over time in the tree fruit industry. The 1973 census was an

invaluable aid as a management tool, providing details on tree numbers, location, size age and variety of fruit. However, it would not serve as a complete guide, since it contains no information on tree rootstocks, strains, tree spacing or acreages devoted to respective fruit varieties. Also, because all orchards were surveyed, the census represents a relatively expensive means of obtaining information related to orchard condition.

Simple statistical profiles of orchard spacing, tree numbers, rootstocks, etc., do not reveal the complete picture behind the need to renovate an orchard. Adequate records on costs and returns for the orchard are also required for such management. Management factors such as adherence to spray schedules, tree training and pruning practices, matching rootstocks to appropriate soil type, and others, all play a role in determining whether trees should be removed. Such details represent an assessment that is largely subjective in nature, and which can only be made by trained horticulturists through direct visual inspection of tree fruit blocks. To obtain such an assessment, a field survey based on a sample of tree fruit producers throughout the Okanagan and Kootenay regions is required.

2. RESEARCH OBJECTIVE AND METHODOLOGY

2.1 Objective

The objective of this study is to document the state of the tree fruit orchards in the Okanagan-Kootenay Region; to identify the extent of orchards requiring renovations; and the potential cost of replacing old and poor trees.

In order to obtain information on the tree fruit production base in the Okanagan-Kootenay region, a field survey of growers was undertaken. The survey includes information showing acres, variety, rootstock type, spacing, tree size categories (ie. standard, semi-standard, semi-dwarf, and dwarf), and the year of planting of individual blocks on tree fruit farms. These data were to be extracted from a representative, stratified sample of all orchards in the region.

Survey data are tabulated to facilitate an analysis of the compiled information regarding the extent and cost estimates of the orchard renovation or upgrading of higher density orchards identified in the sample.

2.2 Study Methodology

Research methods employed to obtain information can be described in two parts: development of the survey questionnaire, and; determination of the sample size to which the questionnaire was administered. Each of these tasks is described separately in the following sub-sections.

2.2.1. Survey Questionnaire

Discussions were held with provincial extension specialists and Mr. Alec Watt, former supervising district horticulturist (retired), in order to prepare the survey questionnaire. This 'advisory group', provided invaluable input regarding the format and content of the proposed questions. At their recommendation, the components dealing with the strain of particular fruit varieties (especially with respect to apples), yield potential and grade potential were added to those values required by the study terms of reference. These additions provided those applying the questions during the survey fieldwork, with added background information to growers' tree replacement decisions and orchard conditions. Details which document the questionnaire variables, format and underlying rationale are provided in the Appendix. Accompanying the documentation is a list of factors which were expected to affect the need for renovation. These factors were prepared prior to administration of the questionnaire and served as a guide to interviewers during the course of survey work.

2.2.2. Sample Design

As originally requested, the study terms of reference stated that survey data would be used to extrapolate results from "....a representative stratified sample of all orchards in the (Okanagan-Kootenay) Region. Sampled growers will consist of a minimum of 5% of all orchards in the Region with a more intensive 20-25% survey of growers in the Kelowna area. This sampling rate

would have meant that 200 growers were required for the survey. Hence the project was designed and budgeted accordingly. However, as work began and data limitations became known, it was clear that a sample size of 200 growers may be insufficient to meet all of the requirements intended in the original terms of reference and budget. The reasons for this are as follows:

1. As interpreted, the terms of reference called for a statistically representative sample to include six key variables, each of which play an important role in whether fruit trees require replacement.

2. Given the tremendous range of choices open to growers regarding the different combinations of the six variables, it would be unlikely that statistically reliable estimates of industry conditions could be drawn relative to each of the variables chosen from a sample of only 200 producers.

3. Further, data on the total population or numbers of trees bearing characteristics of each variable is not available either on a regional or industry basis. Since the determination of statistically reliable sample sizes depends on the proportions of the sample relative to the population as a whole, a representative sample selection could not be assured.

4. The decision to make tree replacement/renovation decisions is not always determined by each of the variables acting in an independent manner. That is, age, for example, does not in itself indicate that a tree is no longer suitable for production. Age, acting in concert with another variable (say variety) may provide a more reliable description of the need for orchard renewal.

The implications of the above are that, from a sample of 200 growers, results would not enable the analyst to make statistically reliable statements related to the condition of orchards involving two or more of the requested variables. For example, if the sample of 200 growers showed that trees on M111 rootstock and 20 years of age made up 20% of the total trees requiring replacement, this would not enable the researcher to

say that 20% of all orchards consisted of trees on M111 rootstock at 20 years old. A sample of 200 growers would be unlikely to contain a sufficient proportion of the actual numbers of 20-year old trees or trees on M111 rootstock, to enable reliable estimates to be made regarding the interaction of the two variables. Where information is required from a sample in order to make predictions regarding more than one factor or variable related to the industry, the additional factors may require a larger sample size in order to maintain the reliability of estimates within acceptable confidence limits.

Simple random sampling of growers in order to determine the likely extent of the need to replace trees of a particular type of fruit is possible within a sample size of 200 growers. Since sufficient information regarding the relative mix of fruit types amongst B.C. fruit growers was available from which to draw a sample survey, it was decided to proceed with the study on this basis. Because apples are grown by an estimated 90% of all tree fruit producers, the sample selection procedure was based on apples with the likelihood that sufficient data could be drawn on the other fruit types.

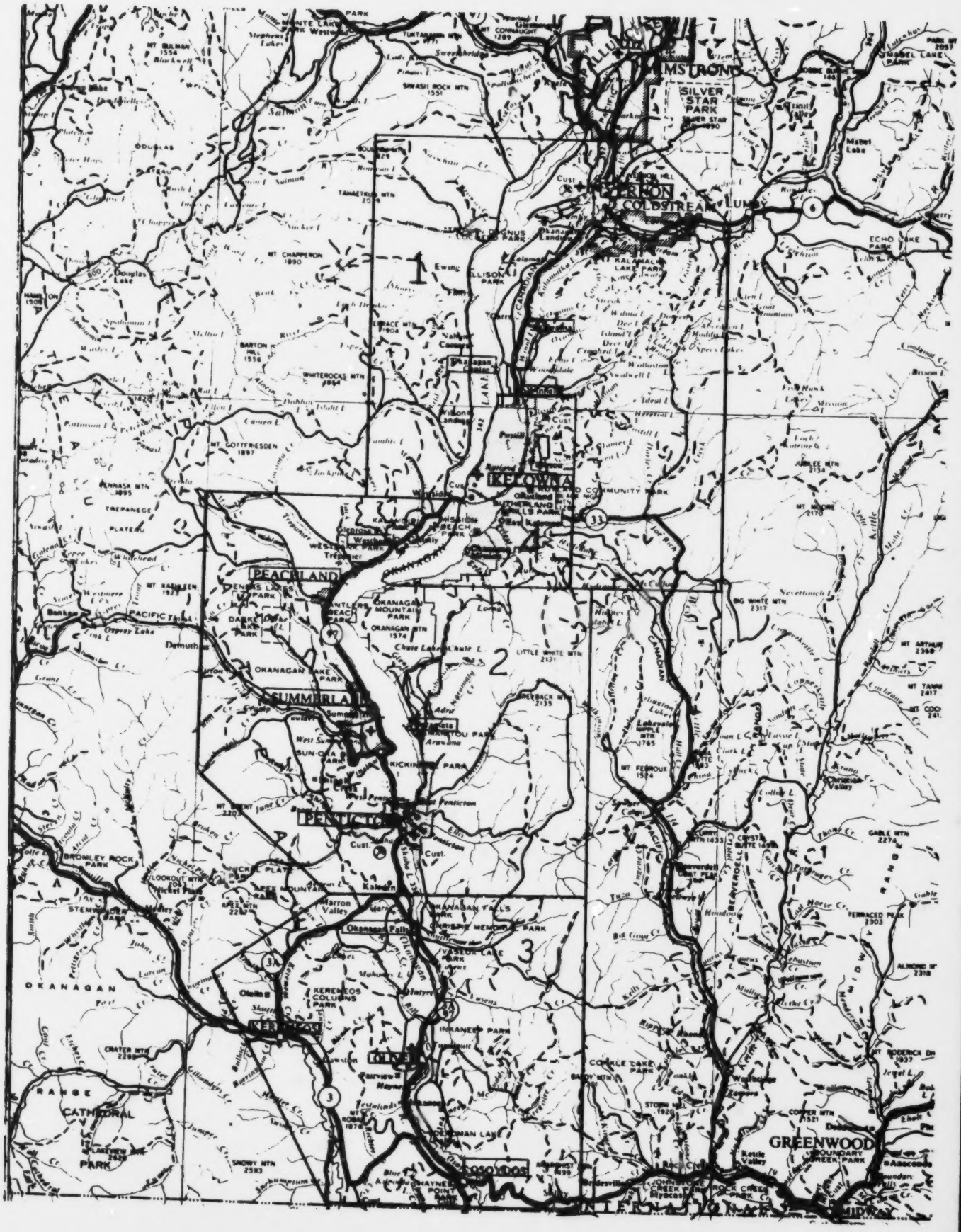
Statistically representative estimates of orchard condition involving the more complex issue of interactions between the six variables may be drawn at a later date through the use of information generated by this report. Summary results from this survey may be employed in later, more detailed analyses of key physical or management variables through a procedure known as

"post stratification'. Based on the proportions of the key variables within the sample of 200 growers, the results could be utilized as if they were representative of the true population for each of the variables chosen. From these known proportions, a new sample could be drawn in numbers which would reliably represent the characteristic for the industry or region as a whole. Currently, no information is available regarding such characteristics as the number of producers who possess trees on a particular rootstock, strain, density, or various other attributes relevant to the physical composition of the fruit tree population. This report represents a starting point for the gathering and future use of such information.

With this post stratification procedure in mind, the Okanagan-Kootenay region was sub-divided into five regions corresponding to the cultural areas for commercial orchard plantings. These regions conform to the following areas: (see map)

Region	Cultural Area(s)
1.	Vernon, Okanagan Centre, Oyama, Winfield
2.	Westbank, Peachland, Summerland, Penticton, Naramata, Kaleden
3.	Okanagan Falls, Oliver, Osoyoos, Keremeos, Cawston
4.	Kelowna
5.	Creston

Though the initial sample structure was unaffected by this regional breakdown, it lends itself readily to post stratification sampling if more detailed surveys are requested at a later date.


VERNON
COLDSTREAM
KELOWNA
PEACHLAND
SUMMERLAND
PENTICTON
OKANAGAN FALLS
KEREMEOS
OLIVER
OSOYOOS
GREENWOOD
MIDWAY
SILVER STAR PARK
OKANAGAN MOUNTAIN PARK
OKANAGAN LAKE PARK
KALAMALKA LAKE PARK
OKANAGAN
CATHEDRAL
RANGE
1
2
3
3A
97
33

Using the distribution of the number of each type of tree fruit planting determined from the 1973-74 tree census, the formula listed below, was used to calculate sample numbers for the orchard condition survey:

$$\text{Sample size, } n = \frac{n(0)}{1 + (n(0) - 1)/ N}$$

Where n(0) represents an initial estimate of the sample size, equal to a the following:

$$n(0) = \frac{t\ (p)\ (q)}{d}$$

t represents t-squared, and is obtained from the value of the abscissa of the normal curve for a probability of 10% (ie. t= 1.645 squared, or 2.71), and;

p represents the proportion (percentage) that a given variable versus the population (eg. apples in a region as a percent of all apple plantings in the industry).

q represents the proportion (percentage) of plantings not represented by p above. (ie. q = 1-p). For example, the percentage of plantings in a region that are not apple plantings.

d represents the level of precision that the analyst wishes his calculated sample to represent relative to the actual value in the population. (ie. d=.10 in cases where the analyst wishes his estimate to lie within +/- 10% of the true population value.

Given the above formula, the sample formula employed the following regional percentages for apples as a proportion of total apple plantings by region:

Region	Percentage
1	16%
2	25%
3	31%
4	19%
5	9%

By substituting these percentages in the above formula, the number of growers required to estimate the degree of orchard replacement for apples was determined for each region as listed below:

Region	No. of Producers
1	32
2	46
3	53
4	37
5	19
Total	187

Thus, a minimum of 187 growers were required in order to provide a reliable estimate of the number of apple trees and area affected by proposed producer renovation activities. The number of growers actually contacted remained at approximately 200 in accordance with the original terms of reference and the project proposal submitted under terms of the study contract.

2.2.3. Sample Selection

Once the sample sizes for each region were determined, specific growers were selected from membership lists available at packing houses located in each area. Names and addresses were selected at random from the lists and growers were contacted for personal interviews.

To help expedite the interview process, a copy of the most recent

tree census for the prospective candidate's orchard was obtained wherever possible. Frequently, the tree census was not available for a particular grower. In such cases, the producer's tree count from his crop insurance records proved helpful in verifying tree numbers for particular blocks whenever an operator had difficulty describing the orchard.

3. SURVEY FINDINGS AND ANALYSIS

3.1 Sample Description

For the 201 orchards contacted during the survey, the number of plantings described in the course of personal interviews is described below:

Region	#Orchards	#Plantings	Avg.#Plantings Per Orchard
1	34	352	10.4
2	52	869	16.7
3	55	1109	20.2
4	39	563	14.4
5	21	217	9.9
Total	201	3110	15.4

Note: Plantings here, are defined as trees of uniform age, variety and rootstock growing in the orchard. This does not indicate a 'block' of trees, which would imply that uniform trees were planted in the same physical area.

Together, growers operated a total of 2586.1 acres of orchard with 78.9% of that area devoted to apple production (2042.2 acres). The most common variety of apple grown was Red Delicious, which represented approximately 44% of all apple trees grown by the producers sampled. In terms of the rootstock types and tree densities identified during interviews, standard types predominated--accounting for 17% of total trees and 22% of the land area devoted to apples in the survey. For soft fruit, all rootstocks were standard type, since no commercial dwarfing rootstocks are available for such trees. Planting configurations were extremely varied in spacing but the resulting density of the

orchard layouts could be classed as 'low density' systems. Most plantings of fruit were less than 200 trees per acre; proportions ranged from a level of 66% of all plantings for apples to 98% of all cherry plantings at 200 trees per acre or less.

Growers with crop insurance numbered 154 of the total sampled, or about 77%.

The following subsections describe the survey findings in more detail with respect to the key variables outlined in the survey objectives (ie. acreage, variety, rootstocks, spacing/density, size and age). Tables are presented to summarize the survey results on a regional basis by type of fruit.

3.2 Acreage

Table 3.1 outlines the regional distribution of the area devoted to the seven types of tree fruit. Of the total 2586.1 acres represented by the sample, 79% (2042.2 acres) is planted to apples, 8% (203.9 acres) to pears, 4.6% (119.1 acres) to cherries, 4.8% (123.8 acres) to peaches, 2.1% (55.6 acres) to apricots, 1.5% (37.6 acres) to prunes, and .2% (3.9 acres) to plums. A comparison of the survey data with statistics from the 1981 agricultural census for British Columbia is given below:

	Survey Breakdown	Agricultural Census
	%	%
Apples	78.9	69.0
Pears	7.9	7.6
Cherries	4.6	9.2
Peaches	4.8	8.5
Apricots	2.1	2.3
Prunes	1.5	3.4*
Plums	.2	-

* Note: Agriculture Census for B.C. in 1981 combined Prune and Plum acreage.

TABLE 3.1

ACREAGE PLANTED BY TYPE OF TREE FRUIT
GROWER SURVEY

FRUIT TYPE	REGION 1	REGION 2	REGION 3	REGION 4	REGION 5	TOTAL	TOTAL %
Apples	293.4	397.4	462.5	681.3	207.6	2042.2	78.9
Pears	23.7	47.1	44.6	85.5	3.0	203.9	7.9
Cherries	14.0	33.5	45.7	24.1	1.8	119.1	4.6
Peaches	2.7	35.2	81.8	-	4.1	123.8	4.8
Apricots	.1	31.5	22.9	-	1.1	55.6	2.1
Prunes	.6	4.3	26.2	6.1	.4	37.6	1.5
Plums	-	.7	2.7	-	.5	3.9	.2
TOTALS	334.5	549.7	686.4	797.0	218.5	2586.1	100.0

With the exception of peaches and cherries, the survey proportions represent a reasonably close approximation of the industry distribution of commercial varieties, though the survey sample was not designed in advance to accomplish this relationship. Had sufficient data been available with which to prepare appropriate grower selection criteria, steps could have been taken prior to survey initiation in order to select a more closely representative sample of growers.

Almost every grower contacted had at least one planting of apples--only 6 growers did not have apples. Of the remaining types of fruit, 78 growers had pears, 89 growers had cherries, 78 had peaches, 41 had apricots, 50 had prunes and only 15 had plums. Generally the northern regions of the survey (ie. regions 1 and 4) represented the majority of apples and pears, while the southern regions (primarily 2 and 3, with some in 5) constituted the most significant soft fruit growing areas in terms of both area and number of trees.

3.3 Variety

Since growers in the survey sample relied primarily on apples for commercial production, the orchard renovation and tree replacement activities reported are oriented to varieties within the apple group. The relative proportions of the respective varieties available to apple growers are best described in terms of tree numbers. Table 3.2 provides a tree population comparison for commercial varieties. Red Delicious trees predominate (41%)

and are followed by McIntosh (31%), Spartan (13.5%) and Golden Delicious (8%).

3.4 Type of Rootstock

The effect of rootstock selection in orchard production is a factor in replacement/renovation decisions for apples more than for any other type of fruit. Since specific rootstocks are known to be inappropriate to Okanagan and Kootenay growing areas, or particularly susceptible to disease problems under B.C. conditions, rootstocks were identified in the survey questionnaire. Since a wide range of rootstocks are employed commercially in B.C., Table 3.3 identifies 16 separate types within the tree size categories of standard, semi-standard, semi-dwarf and dwarf for apples. It became apparent during the course of grower interviews that not all producers could provide accurate information as to the rootstocks on which their trees were grown. Because growers had purchased their orchards from a previous operator, they frequently had no knowledge of the particular rootstock within a block other than that the trees were of a semi-standard, semi-dwarf, etc. 'type'. Where this situation occurred, information on tree numbers was collected on the basis of the 'type' of rootstock which the grower believed the trees in question to be planted.

TABLE 3.2

NUMBER OF APPLE TREES BY VARIETY
- GROWER SURVEY -

VARIETY	REGION 1	REGION 2	REGION 3	REGION 4	REGION 5	TOTAL	TOTAL %
DELICIOUS							
- Red	13377	35597	45651	46503	8619	149747	41.4
- Golden	2607	6637	13747	4173	577	27741	7.7
McINTOSH	20080	29009	11768	32597	18946	112400	31.1
SPARTAN	7210	12815	4772	18473	5633	48903	13.5
C. DELICIOUS	-	-	558	28	88	674	.2
TYDEMAN	241	2868	1814	362	26	5311	1.5
RED ROME	392	128	619	280	-	1419	.4
G. SMITH	25	-	4982	20	-	5027	1.4
NEWTOWN	-	6224	1743	-	-	7967	2.2
OTHER	-	328	718	5	1068	2119	.6
TOTAL	43932	93606	86372	102441	34957	361308	100.0

TABLE 3.3
NUMBER OF APPLE TREES BY TYPE OF ROOTSTOCK
- GROWER SURVEY -

ROOTSTOCK	REGION 1	REGION 2	REGION 3	REGION 4	REGION 5	TOTAL
Seedling	0	0	0	4169	0	4169
Antonovka	3629	5333	9786	7071	6357	32176
Standard	13577	17740	18786	32740	3420	86263
Sub-Total	17206	23073	28572	43980	9777	122608
M2	2574	4486	5624	7463	2186	22333
M104	458	2260	1920	2312	140	7090
M111	7568	8589	6426	7282	2701	32566
A2	350	533	824	0	0	1707
S-Standard *	3683	8170	7020	264	585	19722
Sub-Total	14633	24038	21814	17321	5612	83418
M4	1641	14060	7395	5822	680	29598
M7	2261	4948	6831	7117	8193	29350
M7A	0	0	970	0	2130	3100
M26	6498	12158	12811	19371	6270	57108
M106	0	20	360	2518	260	3158
S-Dwarf *	1043	8614	4833	634	435	15559
Sub-Total	11443	39800	33200	35462	17968	137873
M9	250	3931	2426	1492	731	8830
Dwarf *	400	2764	360	4186	869	8579
Sub-Total	650	6695	2786	5678	1600	17409
TOTAL	43932	93606	86372	102441	34957	361308

* Size category was designated in cases where growers were unable to identify specific rootstocks.

On the basis of discussions with growers interviewed, producers appear to be moving toward planting rootstocks within the semi-standard and semi-dwarf categories outlined in Table 3.4. However, they mentioned having problems with M104 and M111 rootstocks (crown rot) in the semi-standard category, and M7 and M106 rootstocks (crowding due to vigour & spacing, and crown rot respectively) in the semi-dwarf category. The rootstocks M104, M111 and M106 have carried a crown rot susceptibility warning to growers for some time, but growers who mentioned encountering this disease offered a mixed reaction in terms of their awareness of the caution on these rootstocks. The crowding on the M7 rootstock, appears to vary in relation to complainants' soil type, irrigation application rates and pruning practices. Problems seem to arise in response to management rather than with respect to the suitability of the rootstock--crowding often resulted from planting rows too close together, with no mention of any problem with tree health or production performance. A similar situation was mentioned for the M26, semi-dwarf rootstock. On lighter soils, the M26 is reported to have a tendency to lean or grow at an angle when under a load of fruit as a result of poor root anchorage in some Okanagan areas. Again, no complaints with the rootstock itself, problems have arisen for growers who were unaware of this tendency until actual experience was gained after planting in their orchards. Additional propping of trees during the growing season enables them to cope with the problem. However, once propped, realigned trees seldom regain lost productivity or vigour.

TABLE 3.4

NUMBER OF APPLE PLANTINGS BY TYPE OF ROOTSTOCK
- GROWER SURVEY -

ROOTSTOCK	REGION 1	REGION 2	REGION 3	REGION 4	REGION 5	TOTAL
Seedling	0	0	0	23	0	23
Antonovka	22	37	60	36	12	167
Standard	101	185	182	192	40	700
Sub-Total	123	222	242	251	52	890
M2	15	33	30	36	4	116
M104	5	26	14	12	2	59
M111	51	20	62	33	15	180
A2	1	6	6	0	0	13
S-Standard *	31	52	70	2	4	158
Sub-Total	103	137	182	83	25	530
M4	10	50	20	32	3	114
M7	14	33	47	44	34	172
M7A	0	0	2	0	6	8
M26	36	85	44	55	41	256
M106	0	2	5	7	3	17
S-Dwarf *	6	26	29	3	3	67
Sub-Total	66	196	147	141	90	640
M9	1	6	8	7	4	26
Dwarf *	2	6	3	12	6	29
Sub-Total	3	12	11	19	10	55
TOTAL	295	567	582	494	177	2115

* Size category was designated in cases where growers were unable to identify specific rootstocks.

The number of plantings or blocks which correspond to the number of trees reported for each rootstock in Table 3.3 are shown in Table 3.4. This information serves to outline the fact that growers frequently resort to multiple plantings of a given rootstock within their orchards; often over a period of years and, in some cases, with varying densities of the rootstock.

3.5 Tree Density

Discussions with provincial district horticulturists before embarking on the survey indicated that the majority of orchardists had not adopted high density production practices as yet. The survey results in Table 3.5 support this assessment very strongly.

From 1981 census data on tree numbers for British Columbia orchard acreages by type of fruit, the average densities of plantings ranged from 156 trees per acre for apples to between 84 and 108 trees per acre for other types of fruit, excluding peaches (which average 182 trees per acre). Though opinions as to what density constitutes a 'high density' planting level vary, 300 trees per acre could be considered to be a practical cut-off level in terms of the Okanagan and Creston areas (some would say 500 trees per acre). From Table 3.5, 71% of trees planted in survey orchards were grouped at rates of 200 trees per acre or less. The sample results for each type of fruit compared to densities based on the 1981 census of B.C. agriculture are

TABLE 3.5

DENSITY OF TREE FRUIT PLANTINGS
- GROWER SURVEY -

FRUIT TYPE	NO. PLANTINGS BY DENSITY CATEGORY (Trees/Acre)							
	50-	50-100	100-200	200-300	300-400	400-500	500+	TOTAL
APPLES	93	176	1124	447	145	66	64	2115
%	4.4	8.3	53.2	21.1	6.9	3.1	3.0	
PEARS	3	34	128	23	5	-	-	193
%	1.6	17.6	66.3	11.9	2.6			
CHERRIES	37	69	178	7	-	-	-	291
%	12.7	23.7	61.2	2.4				
PEACHES	-	4	196	51	39	6	2	298
%		1.3	65.8	17.1	13.1	2.0	.7	
APRICOTS	2	26	65	9	2	-	-	104
%	1.9	25.0	62.5	8.7	1.9			
PRUNES	-	2	63	17	3	-	-	85
%		2.4	74.1	20.0	3.5			
PLUMS	-	1	17	2	2	-	-	22
%		4.5	77.3	9.1	9.1			
TOTAL	135	312	1771	556	196	72	66	3108
%	4.3	10.0	56.9	17.9	6.3	2.3	2.3	100.0

shown below:

Type of Fruit	Avg. Density Grower Survey	Avg. Density 1981 Census
Apples	177	156
Pears	144	108
Cherries	96	87*
Peaches	202	182
Apricots	122	84
Prunes & Plums	179	99*

*Note: Sweet & Sour cherries, and Prunes & Plums totalled respectively to obtain averages for comparison purposes.

Though densities in the survey are slightly greater than those calculated from the 1981 census, the sample averages are considerably below what could be called high density orchards. In fact, 66% of apple trees sampled were planted at less than 200 trees per acre. Proportions below the 200 tree per acre rate for the other types of fruit were respectively: 85% of pears, 98% of cherries, 67% of peaches, 89% of apricots, 76% of prunes and 82% of plums. Hence, even if it were agreed that 300 trees or more per acre constituted high density, B.C. orchards are well below this definition, according to estimates obtained from both the 1981 census and the sample surveyed for this report. Only 11% of all plantings identified were planted at 300 trees per acre or more for all types of fruit. For apples, approximately 13% of all trees in the survey exceeded a 300 trees per acre rate.

3.6 Tree Size

Distinctions between the tree size categories for tree fruit (standard, semi-standard, semi-dwarf and dwarf), apply exclusively to apples since only standard trees were encountered for the other types of fruit in the survey. Table 3.6 provides a breakdown of the tree counts for these size categories by region and for the entire sample.

For the sample, the tree count is split 57% - 43% between the larger size trees (standard & semi-standard) and smaller size trees (semi-dwarf & dwarf) respectively. Intended rates of replacement are greatest for the standard category; 22% of the planted acreage and 17% of the full size tree total. Overall, growers indicated intentions to replace 11% of all trees, which affects a corresponding 16% of the planted land area to apples. Standard and semi-standard size trees constitute 83% of total apple trees to be replaced and 92% of the land base on which apple trees are to be removed.

Regionally, the greatest proportion of standard size trees sampled is in Region 4 (Kelowna), with 44%. However, the region with the highest rate of replacement for standard trees is Region 3 (Oliver-Osoyoos), with 26% of the planted area designated for replacement (53 out of 205 acres) and 22% of the trees. Of the 77 acres targeted for renewal activity in Region 3, standard trees account for 69% of the area planted to apples (ie. 53 out

TABLE 3.6

TREE REPLACEMENT SUMMARY - APPLES
BY SIZE CATEGORY

TREE SIZE CATEGORY & REGION	(1) TOTAL TREES	(2) TOTAL ACRES	(3) TREES TO REPLACE	(4) ACRES TO REPLACE	(5) /1 NR/NT (%)	(6) /2 ACR/AC (%)
REGION 1						
STD	16722	139.2	2129	26.1	12.73	18.75
SSTD	15367	102.9	1555	13.1	10.12	12.73
SDWF	11193	49.6	30	.1	.27	.20
DWF	650	1.7	0	0.0	-	-
SUB-TOTAL	43932	293.4	3714	39.3	8.45	13.39
REGION 2						
STD	24074	150.5	4178	32.3	17.35	21.46
SSTD	23164	103.8	3691	18.0	15.93	17.34
SDWF	39673	131.7	1406	3.5	3.54	2.66
DWF	6695	11.4	1400	2.0	20.91	17.54
SUB-TOTAL	93606	397.4	10675	55.8	11.40	14.04
REGION 3						
STD	28747	204.9	6444	52.8	22.42	25.77
SSTD	21639	138.4	2341	18.1	10.82	13.08
SDWF	33200	113.6	1504	6.3	4.53	5.55
DWF	2786	5.6	20	.1	.72	1.79
SUB-TOTAL	86372	462.5	10309	77.3	11.94	16.71
REGION 4						
STD	45184	416.8	6660	81.6	14.74	19.58
SSTD	16117	94.4	2711	23.6	16.82	25.00
SDWF	24025	92.4	1412	7.5	5.88	8.12
DWF	17115	77.7	100	.5	.58	.64
SUB-TOTAL	102441	681.3	10883	113.2	10.62	16.62
REGION 5						
STD	9777	93.8	1809	30.0	18.50	31.98
SSTD	6072	32.6	120	.7	1.98	2.15
SDWF	17508	75.3	813	4.0	4.64	5.31
DWF	1600	5.9	0	0.0	-	-
SUB-TOTAL	34957	207.6	2742	34.7	7.84	16.71
ALL REGIONS						
STD	124504	1005.2	21220	222.8	17.04	22.16
SSTD	82359	472.1	10418	73.5	12.65	15.57
SDWF	125599	462.6	5165	21.4	4.11	4.63
SWF	28846	102.3	1520	2.6	5.27	2.54
TOTAL	361308	2042.2	38323	320.3	10.61	15.68

/1 Column (3) divided by column (1). Number of trees for replacement/total number of trees surveyed.

/2 Column (4) divided by column (2). Number of acres affected by replacement or renovation/total acres surveyed.

of 77 acres of apples slated for replacement, column 4).

To give some indication of the apple varieties grown on the different tree size categories identified in the sample, Table 3.7 describes the distribution amongst the four major commercial apples.

3.7 Tree Age

A summary of the age distribution indicates the degree to which growers are currently replacing their trees. Trees aged 5 years or less can generally be regarded as non-bearing for most types. In the case of apples, for instance, this is not strictly true (especially for dwarf categories) since trees may bear nominal quantities of fruit after three years. However, in terms of commercial production levels, the 5-year level provides a useful guideline for bearing and non-bearing fruit tree populations.

As for rootstocks, growers frequently were unable to recall precise dates of planting for all plantings within their orchards. In most cases, ages were provided with reasonable accuracy, but where memories were uncertain, interviewers resorted to two alternative courses of action:

1. Growers were asked to refer to an age range in which trees were likely to have been planted.
2. The tree census was utilized as a guide to planting dates where grower memories were unable to identify dates for their older blocks.

These approaches enabled the age distribution drawn in Table 3.8 to be as accurate as possible, given that many years may have

TABLE 3.7

NUMBER OF TREES FOR MAJOR APPLE VARIETIES
BY SIZE CATEGORY
- GROWER SURVEY -

VARIETY/ SIZE	REGION 1	REGION 2	REGION 3	REGION 4	REGION 5	TOTAL
RED DELICIOUS						
Standard	5688	9035	19076	23745	1540	59084
S-Standard	5675	11978	11274	5849	2160	36936
S-Dwarf	1614	12655	14976	12122	4389	45756
Dwarf	400	1929	325	4787	530	7971
Sub-Total	13377	35597	45651	46503	8619	149747
GOLDEN DELICIOUS						
Standard	1141	2294	3581	1457	-	8473
S-Standard	812	1186	3636	334	10	5978
S-Dwarf	654	1522	4640	1720	290	8826
Dwarf	-	1635	1890	662	277	4464
Sub-Total	2607	6637	13747	4173	577	27741
McINTOSH						
Standard	6339	7430	3871	10067	7981	35688
S-Standard	5889	5701	3489	5148	3456	23683
S-Dwarf	7602	15254	4408	7454	7062	41780
Dwarf	250	624	-	9928	447	11249
Sub-Total	20080	29009	11768	32597	18946	112400
SPARTANS						
Standard	3033	2994	855	9796	62	16740
S-Standard	2854	2818	1871	4424	446	12413
S-Dwarf	1323	6865	2011	2515	4980	17694
Dwarf	-	138	35	1738	145	2056
Sub-Total	7210	12815	4772	18473	5633	48903
TOTAL	43274	84058	75938	101746	33775	338791

TABLE 3.8

SUMMARY AGE PROFILE OF TREES
BY FRUIT TYPE
- GROWER SURVEY -
(No. of Trees)

FRUIT TYPE	AGE BREAKDOWN 1-5	6-10	11-15	16-20	21-25	25+	TOTAL
Apples	103971	51340	75803	74968	28668	26558	361308
Pears	3296	1535	5447	6223	4611	8273	29385
Cherries	2587	1613	1189	1738	941	3420	11488
Peaches	7920	7059	6320	2216	743	809	25067
Apricots	2253	1980	856	425	252	1028	6794
Prunes	685	1252	1719	2417	255	337	6665
Plums	386	10	169	150	-	49	764
TOTAL	121098	64789	91503	88137	35470	40474	441471

FRUIT TYPE	PERCENTAGE DISTRIBUTION 1-5	6-10	11-15	16-20	21-25	25+	TOTAL
Apples	28.8	14.2	21.0	20.7	7.9	7.4	100
Pears	11.2	5.2	18.5	21.2	15.7	28.2	100
Cherries	22.5	14.0	10.3	15.1	8.2	29.9	100
Peaches	31.6	28.2	25.2	8.8	3.0	3.2	100
Apricots	33.2	29.1	12.6	6.3	3.7	15.1	100
Prunes	10.3	18.8	25.8	36.2	3.8	5.1	100
Plums	50.6	1.3	22.1	19.6	-	6.4	100
TOTAL	27.4	14.7	20.7	20.0	8.0	9.2	100

passed since trees were planted, and in some cases, current owners had not been responsible for initial planting.

Approximately 27% of trees for all types of fruit were of non-bearing age. Pears had the oldest profile of the fruit types shown; approximately 44% of trees were over 20 years old. Apricots were the youngest group at 33% under 5 years, 62% under 10 years old. Apples were also young, since 63% were under 15 years of age--still well within the most productive age range for this type of fruit production. Only 9% of all fruit trees surveyed were over 25 years of age.

3.8 Summary of Survey Findings

After compiling data collected for the key survey variables identified for inclusion in the questionnaire, patterns of tree replacement/orchard renovation intentions provide a summary indication of the comparative state of Okanagan-Kootenay tree fruit orchards. Based on calculations applied to the acreage, varieties, rootstocks, density, size and age for the regions employed in the survey design, the data to represent the tree replacement intentions of the industry are provided in Table 3.9.

A total of 441,471 trees were identified during interviews held with growers. Of this number, 50,617 trees (11.5%) were classified as replaceable for all types of fruit. These trees comprised an area of 410.3 acres, or 15.9% of the total 2586.1 acres in the sample. Pears, apricots and prunes, deviated the

TABLE 3.9

TREE REPLACEMENT SUMMARY AREA AND NUMBER OF TREES
BY TYPE OF FRUIT

FRUIT TYPE	(1) NO. TREES	(2) NO. ACRES	(3) TREES TO REPLACE	(4) AREA TO REPLACE	(5) NR/NT /1 %	(6) ACR/AC /2 %
Apples	361308	2042.2	38323	320.3	10.6	15.7
Pears	29385	203.9	6266	48.7	21.3	23.9
Cherries	11488	119.1	1496	15.9	13.0	13.4
Peaches	25067	123.8	2411	12.4	9.6	10.0
Apricots	6794	55.6	413	2.9	6.1	5.2
Prunes	6665	37.6	1598	9.5	24.0	25.3
Plums	764	3.9	110	.6	14.4	15.4
TOTAL	441471	2586.1	50617	410.3	11.5	15.9

/1 Column (3) divided by column (1). Number of trees designated for replacement as a proportion of total trees.

/2 Column (4) divided by column (2). Area of orchard affected by the replacement/renovation as a proportion of total area planted to a particular type of fruit.

most from the survey average replacement rate. However, the deviations from the average did not vary by more than +/- 10%, which is a narrow range within the sample group.

Applying the replacement percentages in Table 3.9 to the acreages devoted to each type of fruit in the Okanagan and Kootenay regions, the sample representation of replacement/renovation requirements may be estimated for the tree fruit industry as a whole. Using acreages for the respective fruit categories obtained in the 1981 Census of Agriculture for B.C., the estimates are presented below:

Type of Fruit	Census Acreage	Replacement Percentage	Estimated Area
Apples	18,977	15.7	2,979
Pears	2,090	23.9	500
Cherries*	2,200	13.4	295
Peaches	2,346	10.0	235
Apricots	642	5.2	33
Prunes & Plums*	935	24.3	227
Total	27,190	15.7	4,269

*Note: Cherries: sweet cherry acreage only, since no sour cherries were encountered in sample.

Prunes & Plums: acres combined for estimation purposes since the census does not separate acreages for each type.

A rate of replacement or renovation of 15-16% cannot be considered excessive, despite the fact that it represents a potential of 417,530 trees. This total tree replacement level is based on the 4,269 acre area estimated above and the 11.5% tree replacement rate in Table 3.9 applied to a total tree population

(bearing + non-bearing) of 4,100,265 from the 1981 Statistics Canada census of agriculture for B.C. In fact, in light of information gleaned from growers as to the reasons for their replacement decisions, the above estimates may be considered conservative.

The survey questionnaire, by design, concentrated to a large extent on the statistical aspects of documenting the status of B.C. orchard condition. Further discussion of the reasons cited by growers for their replacement-renovation practices may provide insight in addition to the tabulations of available data. Before proceeding with cost estimates associated with orchard renewal, some additional impressions regarding general orchard conditions will be brought forward in the following section.

4. FACTORS AFFECTING TREE REPLACEMENT DECISIONS

During the course of interviews conducted to obtain information within a formal questionnaire format, discussions with growers inevitably turned to related orchard management topics. Such conversations arose spontaneously from the question-answer exchange that typifies most producer surveys. Although this did not occur in every case due to time constraints, interview sessions frequently evolved into discussions of why growers selected particular renewal options from those available to them. In addition, interviewers were able to glean information from conversations with industry members who, in their relatively detached positions as administrators, field men, etc., were able to comment objectively on the state of commercial orchards. Such conversations, though not formally documented within a questionnaire format, provide a valuable source of information on which to base assessments of the approaches taken by growers toward upgrading or maintaining orchard productivity. From repeated statements by growers throughout the survey area, a pattern began to emerge regarding certain common problems or attitudes with respect to producers' decision-making on orchard renovation.

4.1 Attitudes to Orchard Renovation

In general, it is apparent from the data that tree replacement activities have been taking place as part of the overall

management duties required of a commercial orchard. At issue are two aspects of the producers' decision from an industry viewpoint; first, the rate at which growers put into effect their replacement practices, and; second, the degree to which producers adopt high density management practices during this orchard renewal process. Attitudes of industry members (represented by fieldmen, district horticulturists and packing organizations) and tree fruit producers appear to diverge since on both the first and second aspects of orchard replacement, growers collectively represent both a relatively slow pace toward tree renewal, and low density orchard management practices. However, when some of the underlying reasons for grower behavior are presented, the divergence between the two groups becomes less pronounced.

All growers recognize the need to renovate their orchards. When to renovate and what to renovate with are decisions which pose the greatest burden on managers. Timing is not simply related to biological factors of age and production performance of trees, but also to economic conditions in the market place for commercial fruit, and growers' financial resource constraints. What to replace non-productive trees with is a decision which must comply not only with economic factors related to timing but also with a producer's personal management abilities or experience. This second factor appears to bear significantly on practical renovation decisions and implies that high density production systems are not necessarily the most preferred alternative in the minds of producers.

A minority of growers sampled (20-25 producers) were averse to the concept of high density plantings. They preferred a low density tree formation (either 20 x 20 feet or 10 x 20 feet) on the basis of having tried more dense configurations and experiencing problems, or through discussions with neighbours who had not been successful under orchard conditions similar to their own. Disadvantages of higher density plantings cited by these growers as having persuaded them to alter their opinion of higher planting rates were as follows:

- semi-standard and semi-dwarf rootstocks planted at less than 15 feet between rows and 8-10 feet between trees within the row often experienced crowding problems at ages ranging between 8-12 years. Growers mentioned having to remove every other tree within the rows in some cases in order to manage trees properly.

- high density plantings represented a uniquely different production system and attendant changes in management practices were required to operate the new system successfully. Growers were not prepared for the sensitive nature of more densely planted trees to changes in application rates for chemicals, fertilizers, etc. or the increased emphasis on the proper timing of orchard operations. Beginners who were unaware of these requirements suffered losses in tree performance and decided that high density systems were not appropriate to their concept of orcharding.

- dwarf or other size controlling rootstocks were planted on poor soil or soil which had previously been planted to the same type of fruit for an extended period. Consequently low fertility or replanting problems resulted in inhibited growth of the newly planted trees. A lack of knowledge regarding potential problems related to replanting on old orchard soils resulted in another bad experience and another source of suspicion that higher density systems were impractical.

- improper pruning and training techniques or not enough pruning of new, high density trees often served to create crowding problems as trees matured.

- because trees on dwarfing rootstocks are closer to the ground, the danger of poor fruit 'set' during spring frost was a factor that deterred growers from exposing themselves to what they considered excessive risks in frost-prone areas.

Orchardists who mentioned a willingness to proceed with renovation toward higher density plantings, rarely indicated densities higher than 300 trees per acre. Most often, the intended number of trees per acre represented an increase over the existing planting rate, but in a range between 200 and 300 trees per acre.

The collective attitude implied by these discussions is one which emphasizes the upgrading of existing orchards. Significant gains are expected by operators from a progressive approach toward improving productivity of tree populations. A movement to slightly higher density, improved productivity and more uniform plantings appears to be the trend prevalent amongst the survey group.

4.2 Producer Tree Replacement/Renewal Practices

Frequently, growers conceded an awareness that their orchard density was too low. However, because orchards were typically small in size (a 12.9 acre average), they were reluctant to remove trees which represented a substantial part of their orchard revenue. Financially they were unable to justify the high short term costs associated with tree removal on a scale which would enable replanting in preferred uniform "block"

planting configurations of fruit trees. For high density systems, some growers indicated that their cashflow would not withstand the cost of trees alone. When foregone income from the bearing trees to be removed under such a replanting scheme was added to preliminary tree and tree planting costs, the decision to move to high density became an infeasible option.

Other growers found that the alternatives chosen in place of block planting practices proved little better. For example, orchardists had resorted to interplanting semi-standard or semi-dwarf apple trees between existing (older) standard trees. This technique placed the new trees within rows of the original standard spacing of 30 x 30. The intent of this approach was to increase the density of trees planted, maintain the production of the existing trees of bearing age and permit development of the newly planted trees until their production permitted removal of the aging standard planting. It was hoped that interplanting would enable a smooth transition from old to new tree stands. In some cases the approach worked. Often interplanting was either unsuccessful, or only partially met grower expectations. The interplanting tends to retard development of the newer trees due to the shading canopy of the fully grown standard trees which surround it. Hence, the new trees take longer to bear fruit, and once bearing, often suffer fruit quality problems due to poor colouration. This poor performance is compounded by employing compact rootstocks on trees which are interplanted. These compact trees are guaranteed to remain under the overhanging

canopy of standard trees even if allowed to develop properly--being under the standard canopy ensures that proper development is less likely.

Growers fully realize that the interplant strategy is less than optimal. As a practical matter for them, immediate cash considerations outweigh the recommended route of block replacement. They are willing to take the risk that interplanting entails; they are 'biding time' until the interplanted trees begin to bear fruit and generate revenue to enable removal of the older trees.

Variations of the interplanting strategy included planting new trees in small blocks or as single rows within the existing orchard layout. These methods appeared to meet with more success in terms of new tree development, though in some cases the new plantings served only to "chop up" the orchard configuration, making the new layout harder to work in terms of spray scheduling, movement of equipment, picking, etc.

Table 4.1 provides an indication of the implications of the frequency with which growers have resorted to small plantings in their orchard layouts. Of the 3110 plantings identified in the survey, 33% of this total consisted of less than .2 acre in size. With an average number of 15 plantings per orchard overall, and average orchard sizes that ranged from only 10 to 20 acres over the five regions, growers appear to be spreading several

TABLE 4.1

NUMBER OF SMALL SIZE PLANTINGS BY FRUIT TYPE
(.2 Acres or Less)

Fruit Type	Region 1	Region 2	Region 3	Region 4	Region 5	Total	%Total(1)
Apples	72	201	167	99	43	582	27.5
Pears	10	31	11	4	5	61	31.3
Cherries	3	54	98	5	3	163	56.0
Peaches	3	30	89	--	9	131	44.0
Apricots	1	20	26	--	5	52	50.0
Prunes	1	11	27	1	1	41	48.2
Plums	--	3	12	--	1	16	72.7
Total	90	350	430	109	67	1046	33.6

types of fruit and a varied number of plantings over a small land area. Neither uniform planting layouts nor specialization of production could be considered a characteristic of the orchards sampled.

The small size of plantings was especially true for soft fruit in Table 4.1. Cherries (56%), peaches (44%), apricots (50%), prunes (48%) and plums (73%) had a high proportion of their plantings within the .2 acre or less size range.

Other replanting or renovation decisions were based on a reaction to problems related to disease, lack of tree development, management difficulties or a combination of all three categories. Table 4.2 enumerates a number of specific problems which growers were able to identify for apples.

TABLE 4.2

REASONS CITED FOR TREE REPLACEMENT OR ORCHARD RENOVATION ESTIMATES, GROWER SURVEY--APPLES
(No. of Trees)

Problem	Region 1	Region 2	Region 3	Region 4	Region 5	Total	%Total
Crowding	1396	5479	3859	5860	695	17289	44.1
Crown Rot	664	90	--	2030	--	2784	7.1
Age	779	--	--	1850	1441	4070	10.4
Canker	--	--	--	595	--	595	1.5
Fair (1)	40	2418	2283	133	521	5395	13.7
Poor (2)	30	1456	280	898	306	2970	7.6
Soil (2)	--	--	--	210	--	210	.5
Other(3)	805	1232	3887	--	--	5924	15.1
Total(4)	3714	10675	10309	11576	2963	39237	100.0

Note:(1) Fair and Poor represent grower assessments concerning tree growth, fruit production, quality performance, etc. as the basis for their replacement/renovation estimates.

(2) Soil problems indicate a lack of tree development due to initial planting on old orchard soil. Poor soil conditions resulted in poor tree growth.

(3) Includes problems resulting from disease, root anchorage, frost damage, etc.

(4) Totals may exceed total trees identified for replacement since some trees may suffer from more than one problem.

Of the total trees to be removed, crowding problems are responsible for the greatest proportion of removal intentions (44%). The crowding has generally arisen through planting trees too close together initially, or inadequate pruning practices which may permit containment of vigorous growth where applied properly and consistently since planting. Growers often resort to removal of every other tree in such cases, to permit continued development of remaining trees. Left unresolved, the crowding would cause reduced production and declining fruit quality from shading and competiton amongst trees planted too close together.

Trees represented by categories "fair" and "poor" have been rated as such by the orchardists contacted. These assessments refer to less than satisfactory production, grade or physical development of the trees in question. More specific reasons were not specified since growers considered a combination of factors to be responsible for their decision to replace the trees identified. Together, the fair/poor condition of trees accounted for approximately 21% of the total replacement for apples.

Tree age accounted for only 10% of the tree replacement volume. Age was often cited in conjunction with some other problem, it was not in itself sufficient reason for removal to a considerable number of growers interviewed. If a tree was 30 years of age and still producing 80% of its full capacity (and fruit of good quality), it was not unusual for growers to indicate that such trees would remain on the orchard for the foreseeable

future.

Crown rot accounted for a further 7% of the trees to be removed. Trees on M111 and M104 rootstocks in Regions 1 and 4 were most commonly affected by this soil borne fungus. Tree fruit production guides for commercial orchardists carry a susceptibility warning on these rootstocks, yet growers were reportedly unaware of the potential problem or at least the degree of severity with which this disease could inflict damage.

5. ORCHARD REPLACEMENT COSTS

5.1 Cost Data and Assumptions

Cost estimates for tree replacement will vary depending on the type of fruit trees being replaced, the density of the planting being removed and the number of trees being planted during the renovation process.

Cost calculations and assumptions underlying the tree replacement process for apples are based on a report sponsored by the B.C.Ministry of Agriculture and Food. The study titled, Estimated Costs and Returns: Apple Orchard Establishment and Production, Okanagan Valley (Economics Branch, BCMA&F, July 1984), represents an excellent reference for the purposes of this study.

Though intended by its authors as a reference for comparison purposes only and not as a representation of any specific orchard, estimates provided in the report constitute the best information currently available for Okanagan orchard conditions. Based on a hypothetical orchard of 20 acres, estimates reflect the resource complement for an orchard of that size. The trees to be replaced are apples spaced at 30 x 30 feet (48 trees/acre); they are to be replaced by apples (spur red delicious) at a 12 x 18 foot spacing on M2 rootstock. It is also assumed that the operator has elected to remove and replant trees in a uniform block layout, as is recommended by horticulturists. Input costs are based on tree fruit production guide recommendations and

current year prices for materials. Cost estimates adapted to this survey reflect those which apply to initial removal of trees and establishment of the new (replacement) planting for year 1 of the BCMA&F report. Table 5.1 summarizes these costs. Since the 202 trees per acre planting modelled in the table appears to reflect general attitudes of surveyed growers toward a 'moderate' increase in orchard density, the costs may also portray a reasonable description of a producer's investment.

Operator labor is included in per acre replacement costs. A value of $8.00 per hour is applied to the number of hours presented for the respective operations in the BCMA&F study. Hired labor is valued at $5.00 per hour. Both values are consistent with underlying assumptions of the cited reference and current values mentioned by growers during the survey.

TABLE 5.1

TREE REMOVAL AND REPLANTING COSTS - APPLES
($ Per Acre)

Operation	Materials Costs	Machinery Costs(1)	Fixed Costs(2)	Hired Labor(3)	Operator Labor(3)	Total Costs
Tree/Root Removal	250.00	--	--	--	384.00	634.00
Land Prep.	--	26.41	40.97	--	28.00	95.38
Auger	--	42.78	57.22	33.75	54.00	187.75
Staking	4.65	--	--	20.00	32.00	56.65
Trees	1131.00	--	--	--	--	1131.00
Planting	--	--	--	50.82	67.20	118.02
Fertilizer	5.73	--	--	--	2.16	7.89
Handseed	30.00	--	--	--	4.00	34.00
Weed,Hoe	--	--	--	--	80.64	80.64
Tree Train, Prune	7.87	--	--	--	26.88	34.75
Mowing	--	15.84	24.03	--	16.00	55.87
Nutrient App.	24.51	7.95	9.69	--	8.00	50.15
Pesticide	2.52	2.63	3.20	--	2.64	10.99
Boron	12.10	1.68	4.12	--	2.16	20.06
Irrigation	70.00	10.80	174.33	--	6.00	261.13
Mouse Guards	110.40	--	--	--	3.20	113.60
Rodent Chem.	2.29	--	--	--	3.20	5.49
Truck Use	--	56.85	60.88	--	64.00	181.73
Sub-Total	1651.07	164.94	374.44	104.57	784.08	3079.10
Buildings & Other		--	57.43	--	--	57.43
Real Estate Taxes		--	45.00	--	--	45.00
Miscellaneous		--	96.03	--	--	96.03
Int. on Op. Capital		--	134.00	--	--	134.00
Total	1651.07	164.94	706.90	104.57	784.08	3411.56

Note:(1) Machinery costs shown are based on total of tractor plus other machinery op. costs in original source.
(2) Fixed Costs equal depreciation + interest on investment costs in original source.
(3) Hired labor costs based on $5.00/hr. Operator labor valued at $8.00/hr.

Note: All other assumptions consistent with those of original source.

Source: BCMA&F, Estimated Costs and Returns, Apple Orchard Establishment, Okanagan Valley, Economics Br., No.266, July 1984.

5.2 Replacement Cost Estimates

Initial establishment costs, including operator labor, amount to $3411.56 per acre (say $3412) from Table 5.1. From Section 3.8, survey results applied to the existing acreage devoted to apple production, an estimated 2979 acres are eligible for tree replacement operations. If it can be assumed that the type of operation described in the BCMA&F report constitutes a conservative representation of expected tree replacement requirements in the Okanagan-Kootenay areas, this value may serve to indicate the general magnitude of the orchard renewal undertaking faced by the industry with respect to apples.

The resulting removal and establishment costs applied to the 2979 acres would then amount to $10,164,348 for the industry (given the $3412/acre value).

However, the removal, establishment and first year maintenance costs associated with the newly planted trees do not fully account for the costs which growers face. Since the new trees cannot be expected to produce an apple crop for the first three years following planting, a grower who renovates must continue to incur on-going maintenance costs for the new block. It is not until year four that trees begin to generate revenue from production, and not until year 7 that sufficient revenue from the output of the new trees actually exceeds production costs associated with the block. Again, the BCMA&F study serves as a guide to the timing of costs and benefits from the renovation

activities. These cost and revenue projections are summarized below:

Year	Replacement/ Production Costs ($/acre)	Estimated Gross Revenue ($/acre)	Net Replacement Costs
1	3412	0	3412
2	854	0	854
3	923	0	923
4	1361	160	1201
5	1542	800	742
6	1760	1600	160
7	2185	2400	(215)

If the original trees at 30 x 30 could have been expected to continue producing for this seven year period, had the replacement decision not been made, the producer would have received an income from those trees. By removing the old planting, the income foregone represents a cost in addition to the replacement costs itemized above. For illustration purposes, assume that the removed trees could have generated net revenues per acre of $766 as is the case for the existing orchard of mature trees in the BCMA&F report (32,000 lbs of apples per acre at $.10/lb=$3200 gross revenue; minus $2434/acre in costs). This 'lost' income, added to the net replacement costs for each of the seven years noted above, constitutes the total producer cost incurred as a result of the orchard renovation decision. When discounted to determine the value of those costs in terms of the current dollar value of the investment decision to a grower (using a rate of 12%), the present value is equal to $9048 per acre. Detailed calculations behind this calculation are presented in the Table 5.2.

TABLE 5.2

SUMMARY OF TOTAL GROWER TREE REPLACEMENT COST CALCULATION
($ Per Acre)

Year	(1) Replace. Costs	(2) Gross Revenue	(3) Net Repl. Cost	(4) Lost Net Income	(5) Total Cost	(6) Discounted Total Cost
1	3412	0	3412	766	4178	3731
2	854	0	854	766	1620	1291
3	923	0	923	766	1689	1202
4	1361	160	1201	766	1967	1250
5	1542	800	742	766	1508	856
6	1760	1600	160	766	926	469
7	2184	2400	(215)*	766	551	249
						$9048

* Note: In year 7 revenue exceeds production costs, thus a net gain is achieved from the replacement operation. Hence brackets to reflect this "negative" cost.

Column (1): replacement and maintenance costs for the new block as per the BCMA&F reference.
Column (2): gross revenue from the new planting.
Column (3): Column (1) minus Column (2) to equal net replacement costs for the new planting.
Column (4): net income which would potentially have been gained, had the original trees remained in place. Based on an assumed yield of 32,000 lbs. of fruit per acre and $.10 per lb. of apples for $3200 gross per acre. Production costs of $2434 per acre (BCMA&F, ibid.) are deducted to give the net of $766 per acre shown.
Column (5): Column (3) + Column (4) to give total replacement costs in current year dollars to growers.
Column (6): Column (5) discounted using a 12% discount rate to indicate the cost of the 7-year investment in terms of its present value to an individual grower. The total of Column (6) represents the total cost to the grower in present value terms per acre.

Source: BCMA&F, Estimated Costs and Returns, Apple Orchard Establishment and Production, No.266, ibid., 1984.

Thus, at $3412 per acre for initial establishment of the new planting, a grower has encountered approximately 40% of the total costs resulting from his replacement decision. This approach results in cost estimates which are sensitive to the underlying assumptions of the nature of the system to be replanted and the density of the proposed new planting. By varying the assumptions, alternative cost estimates may be derived. The primary issue becomes one of the methodology utilized to calculate the replacement costs and the acknowledgement of the income foregone through removal of an existing stand of trees.

5.3 Replacement Cost Estimates For Soft Fruit

Replacement cost estimates for pears, cherries, peaches, apricots, plums and prunes were derived using the same methodology outlined in Section 5.2 for apples. However, slightly different assumptions were employed during the estimation process due to the lower density of soft fruit plantings compared to apples.

Because most soft fruit plantings are spaced at 20 x 20 feet (108 trees/acre), the trees to be replanted were assumed to be replaced by trees at the same density. Initial establishment costs were based on those for apples (Table 5.1) and adjusted to a per tree cost estimate in order to arrive at a value for planting costs associated with a 108 tree block. No data has been published regarding soft fruit establishment costs but

discussions with extension agents suggested that using apple data on a per tree basis would result in comparable estimates suitable for use in this analysis. Since all types of soft fruit are assumed to be planted at 20 x 20 feet spacing, establishment year costs are the same. Cost estimates for soft fruit removal and replanting are presented in Table 5.3. The value estimated for initial tree removal and replanting costs is $2379.

Since no information on replanting costs is available, costs for on-going production of newly planted soft fruit are based on ratios derived from Farm Income Insurance (FII) data. The ratios were obtained from costs used within the FII program for apples and the respective soft fruit. Each per acre FII cost for soft fruit was divided by the per acre FII cost for apples to determine the soft fruit costs relative to the production costs for apples. The derived ratios are shown below:

	Ratio*
Pears	.7059
Cherries	1.6965
Peaches	1.8583
Apricots	1.7917
Plums & Prunes	1.1297

*Obtained using information provided by Farm Income Insurance Branch, BCMA&F, Victoria, February, 1985.

These ratios were then multiplied by the post-establishment year costs for apples shown in Table 5.2 (page 50) of this report (original source: BCMA&F, Apple Orchard Establishment and Production Costs, 1984, ibid.). For example, FII costs for pears, divided by FII costs for apples, resulted in a ratio of

TABLE 5.3

TREE REMOVAL AND REPLANTING COSTS
SOFT FRUIT
($ Per Acre)

Operation	Cost Per Tree(1)	Cost Per Acre(2)
	$	
Tree/Root Removal	5.02	561.60
Land Preparation	*	95.38
Auger	1.75	189.00
Staking	*	56.65
Trees	5.60	604.80
Planting	.60	64.80
Fertilizer	.04	4.32
Handseed	*	34.00
Weed, Hoe	.40	43.20
Tree Train/Prune	.17	18.36
Mowing	.28	30.24
Nutrient Applic.	.25	27.00
Pesticide	.05	5.40
Boron	.10	10.80
Irrigation	1.30	140.40
Mouse Guards	.56	60.48
Rodent Chemical	.03	3.24
Truck Use	.90	97.20
Fixed Costs:		
Buildings & Other	*	57.43
Real Estate Taxes	*	45.00
Miscellaneous	*	96.03
Int. on Op. Capital	*	134.00
TOTAL		2379.33

Note:(1) Data denoted by '*' indicates costs assumed to be the same as those for apples in Table 5.1.

(2) Per acre costs based on a density of 108 trees per acre for the new stand of soft fruit trees. (20 x 20 feet spacing).

Source: Table 5.1, page 47 of this report (ibid.)

implies that annual production and maintenace costs for newly planted pear trees could be represented by taking 70.59% of the costs for apples in each year of the BCMA&F report on apple replanting costs (ie. 70.59% of $854 per acre for apples in year 2 equals $603 per acre in year 2 for pears).

Once costs were derived for each type of soft fruit, corresponding yields for the newly planted trees were derived by using Crop Insurance data for expected per tree production levels for tree fruits at each year of development. Revenues were calculated for the production generated each year by employing 5-year average prices for each from price information supplied by B.C. Tree Fruits Limited. Yields and revenues used are presented in Tables A-1 and A-2 of Appendix 4.

Once this data was assembled, total grower replacement costs were calculated within a format identical to that presented in Table 5.2 for apples. These detailed calculations are provided in Appendix 4, Tables A-3 through A-7 for each type of soft fruit. Annual replacement costs were discounted to present value terms using a discount rate of 12%.

5.3 Summary of Tree Replacement Cost Estimates

Total grower replacement costs are summarized below:

Type of Fruit	Replacement Acreage*	Discounted Total Replacement Cost** ($/acre)
Apples	2979	$ 9048
Pears	500	$10908
Cherries	295	$11432
Peaches	235	$ 6343
Apricots	33	$11809
Plums & Prunes	227	$ 5770

*Acreage from survey estimates in Section 3.8.

**These costs include income foregone as a result of replacing the existing standing of trees. Costs are discounted using a discount rate of 12%. Calculations shown in Tables A-3 to A-7, Appendix 4.

Based on initial establishment costs (per acre,year 1) for apples of $3412 and $2379 for soft fruit, replacement costs for the 4269 acres identified in the survey equal $13.3 million. This is comprised of $10.2 million for apples ($10,164,348) plus $3.1 million ($3,068,910) for the soft fruit acreage (1290 ac. total). If total replacement costs to growers are employed in the preceding calculation (ie. total discounted costs multiplied by replacement acreages for each type of fruit in the table above), the corresponding costs become:

Apples	$26,953,992
Pears	$ 5,454,000
Cherries	$ 4,227,940
Peaches	$ 1,490,605
Apricots	$ 389,697
Plums & Prunes	$ 1,309,790
Total	$39,826,024

This estimate represents approximately $27 million for apples (68%) and $12 million to soft fruit(32%).

6. SUMMARY AND CONCLUSIONS

From the sample of orchardists surveyed, the pattern of responses to questions regarding their respective tree replacement and orchard renovation practices, reveals a collective assessment of the tree fruit industry's orchard condition. The major findings of the survey consist of both the statistical orchard profile and the comments/opinions of industry members and government officials with a close working knowledge of orchard management practices. These findings are summarized below:

Data supplied from the 200 orchardists interviewed during 1984 indicate that, collectively, approximately 11% of the apple trees, 20% of the pears, 13% of the cherries, 10% of the peaches, 6% of the apricots, 1% of the plums and 10% of the prunes require replacement. In terms of the land area, these orchard renovation decisions affect 16% of the apple area (2979 acres), 24% of land currently in pear production (500 acres), 13% of the area in cherries (295 acres), 10% of peach acreage (235 acres), 5% of apricot acreage (33 acres), and 24% of the land devoted to plums and prunes (227 acres).

Estimated costs for the intended replacement levels cited in the survey, were calculated for initial establishment and total grower costs on a per acre basis. For the respective types of fruit grown commercially, the costs are outlined below:

	Establishment	Total Grower Cost
Apples	$3412	$9048
Pears	$2379	$10908
Cherries	$2379	$14332
Peaches	$2379	$ 6343
Apricots	$2379	$11809
Plums & Prunes	$2379	$ 5770

Using the establishment costs incurred during land preparation and initial planting of replacement trees for the types of fruit listed above, orchard replacement costs amount to $13.3 million for the 4269 acre area estimated from survey results. Applying total grower costs associated with initial planting, plus on-

going maintenance costs until new trees come into commercial production, orchard replacement/renovation costs amount to $39.8 million for the 4269 acres affected. Initial establishment costs represent only one-third of the total costs of a grower's decision to replant. Initial planting alone does not account for the years thereafter for which trees are not of bearing age nor for the income a grower foregoes as a result of removing the original bearing trees.

Both individual growers and industry officials contacted during the course of the survey indicated that current renovation/replacement rates lag behind what 'should be done' in order to increase orchard productivity. However, there is no consensus as to what management practices constitute the optimal renovation/replacement strategy to improve orchard condition for the industry. Reasons cited for the fact that renovation rates are less than those desired by planners and the orchardists themselves consist of: a lack of capital with to make improvements, uncertainty regarding general market trends for tree fruit, a lack of management information, a suspicion that high density plantings may not be appropriate to existing management expertise or physical location, operator age, small farm sizes, and a range of other factors related to grower attitudes to change, managerial background, etc.

Significant improvement in orchard productivity could be achieved through renovation of orchards. In some cases, new trees are not what is needed; rather, it is a more manageable configuration of the tree planting arrangement that is needed. Tree crowding, interplanting of small trees under the canopy of larger trees, a mixture of different fruit varieties or even different types of fruit in the same area and small block plantings result in an inefficient orchard layout. Poorly planned tree layouts may increase production costs and can reduce fruit quality. One packing house manager stated that, though the packing line was capable of sorting and packing fruit to specific market orders for size and quality of fruit, the possibility of replicating a given custom order a second time was impossible due to the fact that small, scattered block planting configurations did not permit the packing of fruit of consistent quality in sufficient volumes to meet market orders of this type.

Frequently, growers indicated that there was little information available to determine beforehand the relative merits of alternative types of renovation practices. The costs of tree replacement and land preparation could be estimated readily enough, but the potential payoffs related to different planting densities, rootstock selection, interplanting versus block configurations, and other considerations were not available to them in a form which permitted them to weigh alternative approaches to orchard renewal in any comparative economic sense. This is especially true for soft fruit under B.C. conditions. Additional information regarding the economic consequences of different orchard renovation/replacement strategies would help

alleviate this "information gap".

Extension staff and fieldmen alike, were optimistic that adoption rates for high density plantings will improve. Comments from these individuals provided insightful views on the degree to which this group of experts has dealt with the problem of high density transfer to growers in the Okanagan/Creston areas. A suggestion which was repeated regarding proprosed schemes to encourage planting at higher densities was one which coupled industry extension and individual orchardist participation. A series of demonstration plantings distributed throughout the Okanagan and Creston valleys could be used to demonstrate to participating orchardists and their neighbours, how specific high density systems perform under conditions in their areas.

Any orchard renovation or tree renewal program undertaken by or on behalf of growers will only achieve desired results if the specific option selected is personally suited to a grower's individual managerial ability and orchard location. Problems have arisen in the past with the adoption of relatively new high density production technology. Growers who did not anticipate fully the implications of this type of tree fruit production relative to their knowledge and ability to adapt to the changes in management required to maintain such an orchard, discovered that high density presented a formidable challenge. With this experience in mind, it is apparent that any significant change in rates of renovation/renewal in B.C. orchards will be enhanced if renovation/renewal practices are undertaken with full support of the extension staff employed by the tree fruit industry and the B.C. Ministry of Agriculture.

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APPENDIX 1.

DOCUMENTATION OF SURVEY QUESTIONNAIRE

SURVEY QUESTIONNAIRE

To identify the need for tree replacement in the Okanagan and Kootenay regions, a questionnaire was developed in order to obtain data which would reflect the condition of tree fruit orchards from information available. The questionnaire format was kept at a one page size for ease of handling and to minimize time for each interview. Details collected during the survey included the following:

1. Fruit type: apples, cherries (sweet & sour), apricots, peaches, pears, plums and prunes.

2. Variety: as specified by growers--this was organized so that each variety was covered within its particular fruit type.

3. Strain: as a sub-group within a particular variety, the strain is considered a significant indicator of the need for tree replacement. Cases of inappropriate strains for a given variety have been documented (eg. striped strains of Red Delicious and McIntosh apples are not considered desirable by B.C. Tree Fruits Ltd.). This factor is especially important to apples.

4. Rootstock: since soft fruits are grown primarily on standard rootstocks, this factor applies to apples and acts as an indicator of tree size. The alternative apple rootstocks are grouped by their size categories below:

   STANDARD- SEEDLING, M16, ANTONOVKA, M109, M25

   SEMI-STANDARD- M2, A2, M104, M111

   SEMI-DWARF- M4, M7, M106, M26

   DWARF- M9

5. Number of Trees: the number of trees to correspond to a given variety, strain and rootstock.

6. Tree Spacing: the measurement within rows and between rows (in feet) representing the planting configuration of a block of fruit trees. Again, it is expected that the greatest variation will be for apple plantings. A table (Table) is provided, showing alternative spacing and consequent per acre densities which may be found during the survey.

7.Acreage: the area occupied by the block planting of fruit identified.

8.Tree Size: this variable is used to provide information which represents the area occupied by the trees in the block in relation to the space available for growth and management. Surveyed growers may indicate problems may have arisen since trees were planted due to crowding of branches. Problems of this kind are the result of trees growing too large for the space originally allotted, causing reduced production or poor grading as insufficient light is able to penetrate the tree canopy as fruit reaches maturity. Also, trees may have been spaced too wide, causing land to be under-utilized through an uneven distribution of trees. Fruit grown under such conditions may suffer from 'scalding' as it has been overexposed to the sun during ripening. Where these problems are found to exist, either tree removal (ie. orchard renovation) or additional tree planting would be indicated. During the interview, questionnaires were marked as either: too large; too small; or optimum, to indicate planting characteristics with regard to the above space utilization problem.

9.Age: age in years of trees planted in block.

The following columns (10 through 12) have been added by the surveyers to provide background information as objectively as possible on the level of care or management which trees have received. This information may serve to weight the orchard description comprising columns 1 through 9 of the questionnaire. These additional columns are factors considered important supportive evidence of growers' replacement/renovation needs. Further, and perhaps more important, these items may point to tree removal in spite of data in columns 1-9 and grower indications that replacement is not needed. Such information allows for the real possibility that bad management practices or lack of knowledge, has given rise to the need for tree removal despite the fact that 'all the right things' are in place for the orchard to perform well. Conversely, this side of the questionnaire supports the possibility that, though a grower may protest that trees are beyond redemption, what is needed is not new trees but new management.

Factors affecting the need for orchard renovation are presented in the table following this documentation of the questionnaire on page four below. These factors are behind the decision to incorporate questions into the questionnaire which

would permit this information to be considered within the context of the need for orchard renewal and tree replacement.

10. Condition: as an indication of the level of management applied to a stand of trees, this column is intended to describe the grower's assessment of the trees' condition. Though largely subjective, this judgment permits a qualitative description (ie excellent, good, fair, poor) of trees within a planting with respect to their candidacy for replacement.

11. Yield Potential: as a measure of tree productivity and prospects for continued production, growers are asked to assess tree production performance within each block identified. Expressed as a percentage of potential, 'potential' was defined in relation to crop insurance projections used as guidelines in determining compensation levels for crop losses. These potential yield levels are specified by fruit type only, not by specific varieties, and thus are taken as general guidelines only. For applea, production levels will be applied by type of fruit, and if possible, for the different planting categories developed as representative STANDARD, SEMI-STANDARD, SEMI-DWARF, and DWARF size/densities during the survey.

    Questionnaire responses were based on growers' opinion as to their tree production performance (ie. wether trees were producing at 100%, 80%, 70%, etc. of his assessment of their potential). Once his response was given, the grower was asked what he thought 'potential' meant in terms of pounds per tree or acre production levels. This procedure enabled surveyers to place grower potentials into a standardized perspective. Where trees were performing at less than 40% of their stated potential, they were considered candidates for replacement/renovation.

12. Grade Potential: as with yield potential, an attemp was made to utilize some objective means for assessing grade performance mentioned by growers relative to industry standards. This was not applied through lack of trust of grower remarks but to guard against the possibility that from 200 grower interviews, the survey did not present data based on an inconsistent set of grading values inevitable when personal biases enter into this area. B.C. Tree Fruits and extension agents were

asked for recommendations as to what represented good, fair and poor crop grade breakdowns for respective fruit types (see appendix for a detailed description of these breakdowns).

13. Crop Insurance: this column recorded whether growers were covered by crop insurance for their orchard. Crop insurance may apply to all trees in the orchard, or to different types of fruit--separate blocks or types of fruit is permitted as the scheme is currently offered.

FACTORS AFFECTING THE NEED FOR RENOVATION

1. Fruit variety or strain unsuitable for market. (according to B.C. TREE FRUITS LTD.)

2. Fruit variety or strain grown in wrong cultural area. (according to B.C.M.A.&F. TREE FRUIT PRODUCTION GUIDE)

3. Fruit variety or strain unsuitable for soil or site.

4. Old trees and old style planting (ie. large, standard trees which are too tall to harvest or spray efficiently).

5. Winter injury to trees.

6. Poor tree condition (due to poor management practices, disease, age, etc.).

7. Poor yield performance.

8. Poor grade performance.

9. Trees planted too close together for rootstock, resulting in crowding, por light penetration of leaf canopy, shading (poor coloration) of fruit and obstruction of harvesting operations.

10. Trees planted too far apart, resulting in trees filling less than an optimium amount of the space provided.

11. Pest or disease problems (eg. collar rot, little cherry or other virus, etc.).

12. Planting poorly organized, such as: mixed varieties within a block, soft fruit in with apples, too many small blocs of trees, young trees interplanted with older & larger trees, etc.

GROWER NAME: ADDRESS:

REGION 1 2 3 4 5 PHONE:

1	2	3	4	5	6	7	8	9	10	11	12	13
FRUIT TYPE	VARIETY	STRAIN	ROOTSTOCK	NO. TREES	TREE SPACING	ACREAGE	TREE SIZE	AGE	CONDITION	YIELD POTENTIAL	GRADE POTENTIAL	CROP INSURANCE

APPENDIX 2.

DISTRIBUTION OF FRUIT PLANTINGS, TREE CENSUS, 1974

TABLE A-2
Estimated Number of Plantings by Region and Fruit Type 1975 Census

	Region I	Region II	Region III	Region IV	Region V	TOTAL
Apples	285	452	560	340	157	1794
Cherry-sw	176	453	532	241	31	1533
Cherry-sr	12	13	4	22	10	61
Apricots	43	227	297	42	44	653
Peaches	99	314	496	72	83	1064
Pears	148	396	354	200	121	1219
Plums	32	57	160	13	51	313
Prunes	124	217	428	134	88	991
	Percentage Distribution (x 100)					
Apples	0.1589	0.2520	0.3122	0.1895	0.0875	1.0000
Cherry-sw	0.1148	0.2955	0.3470	0.1572	0.0855	1.0000
Cherry-sr	0.1967	0.2131	0.0656	0.3607	0.1639	1.0000
Apricots	0.0658	0.3476	0.4548	0.0643	0.0674	1.0000
Peaches	0.0930	0.2951	0.4662	0.0677	0.0780	1.0000
Pears	0.1214	0.3249	0.2904	0.1641	0.0993	1.0000
Plums	0.1022	0.1821	0.5112	0.0415	0.1629	1.0000
Prunes	0.1251	0.2190	0.4319	0.1352	0.0888	1.0000
	Percentage Distribution (1-%)					
Apples	0.8411	0.7480	0.6878	0.8105	0.9125	
Cherry-sw	0.8852	0.7045	0.6530	0.8428	0.9145	
Cherry-sr	0.8033	0.7869	0.9344	0.6393	0.8361	
Apricots	0.9342	0.6524	0.5452	0.9357	0.9326	
Peaches	0.9070	0.7049	0.5338	0.9323	0.9220	
Pears	0.8786	0.6751	0.7096	0.8359	0.9007	
Plums	0.8978	0.8179	0.4888	0.9585	0.8371	
Prunes	0.8749	0.7810	0.5681	0.8648	0.9112	

Source: Based on 1974 Tree Census data, BC Tree Fruits Ltd. and BCDA, 1973-74.

APPENDIX 3.

NUMBER OF GROWERS WITH PLANTINGS OF MAJOR TYPES OF TREE FRUIT, GROWER SURVEY

TABLE A-3

NUMBER OF GROWERS WITH PLANTINGS OF THE MAJOR TYPES OF TREE FRUIT - GROWER SURVEY

Fruit Type	Region 1	Region 2	Region 3	Region 4	Region 5	Total (1)
Apples	33	50	55	37	20	195
Pears	10	30	19	12	7	78
Cherries	6	25	46	8	4	89
Peaches	4	23	45	--	6	78
Apricots	1	16	19	--	5	41
Prunes	2	10	32	4	2	50
Plums	--	3	10	--	2	15

Note:(1) The Total column indicates the number of growers who maintained at least one planting or block of the respective types of tree fruit. For example, 195 out of the 201 growers in the survey (97%), had one or more plantings of apples.

APPENDIX 4.

SOFT FRUIT YIELD, REVENUE PROJECTIONS AND REPLACEMENT COST CALCULATIONS

TABLE A-1
YIELD AND REVENUE PROJECTIONS
PEARS, CHERRIES AND PEACHES
ORCHARD CONDITION SURVEY

Year	Pears		Cherries		Peaches	
	Yd	Rev	Yd	Rev	Yd	Rev
1.00	0	0.00	0	0.00	0	0.00
2.00	0	0.00	0	0.00	2500	655.00
3.00	0	0.00	0	0.00	3240	848.88
4.00	0	0.00	540	162.00	7020	1839.24
5.00	0	0.00	1620	486.00	10260	2688.12
6.00	0	0.00	2700	810.00	14040	3678.48
7.00	540	56.16	4320	1296.00	17280	4527.36
8.00	1620	168.48	6480	1944.00	20520	5376.24
9.00	2376	247.10	9180	2754.00	22140	5800.68
10.00	3996	415.58	11880	3564.00	22680	5942.16
11.00	6480	673.92	15120	4536.00		
12.00	9180	954.72	18360	5508.00		
13.00	10800	1123.20	21060	6318.00		
14.00	15660	1628.64	23220	6966.00		
15.00	18900	1965.60	25380	7614.00		
16.00	22680	2358.72				
17.00	25380	2639.52				
18.00	28080	2920.32				
19.00	29160	3032.64				
20.00	31320	3257.28				

TABLE A-2
YIELD AND REVENUE PROJECTIONS
APRICOTS, PLUMS AND PRUNES
ORCHARD CONDITION SURVEY

Year	Apricots		Pl.&Prune	
	Yd	Rev	Yd	Rev
1.00	0	0.00	0	0.00
2.00	0	0.00	0	0.00
3.00	540	108.00	540	72.90
4.00	1620	324.00	1620	218.70
5.00	3240	648.00	3240	437.40
6.00	6480	1296.00	5940	801.90
7.00	10260	2052.00	8640	1166.40
8.00	14580	2916.00	11340	1530.90
9.00	18900	3780.00	14040	1895.40
10.00	23220	4644.00	16740	2259.90
11.00	27540	5508.00	19440	2624.40
12.00	31860	6372.00	22140	2988.90
13.00	35640	7128.00	23760	3207.60
14.00	38340	7668.00	24840	3353.40
15.00	39960	7992.00	25380	3426.30

TABLE A-3
TREE REPLACEMENT COST CALCULATION
ORCHARD CONDITION SURVEY
PEARS

Year	Pear Cost	Pears Yd	Pear Rev	Net Rep Cost	Lost Net Rev	Total Cost	Discount Factors	PV Cost
1	2379	0	0	2379	380	2759	0.8929	2463
2	603	0	0	603	380	983	0.7972	783
3	652	0	0	652	380	1032	0.7118	734
4	961	0	0	961	380	1341	0.6355	852
5	1088	0	0	1088	380	1468	0.5674	832
6	1242	0	0	1242	380	1622	0.5066	821
7	1542	540	56	1485	380	1865	0.4523	843
8	1643	1620	168	1474	380	1854	0.4039	749
9	1744	2376	247	1496	380	1876	0.3606	676
10	1845	3996	415	1429	380	1809	0.3220	582
11	1946	6480	673	1272	380	1652	0.2875	474
12	2047	9180	954	1092	380	1472	0.2567	377
13	2148	10800	1123	1024	380	1404	0.2292	321
14	2249	15660	1628	620	380	1000	0.2046	204
15	2346	18900	1965	380	380	760	0.1827	138
16	2346	22680	2358	-12	380	367	0.1631	59

TABLE A-4
TREE REPLACEMENT COST CALCULATION
ORCHARD CONDITION SURVEY
CHERRIES

Year	Cherry Cost	Cherry Yd	Cherry Rev	Net Rep Cost	Lost Net Rev	Total Cost	Discount Factors	PV Cost
1	2379	0	0	2379	595	2974	0.8929	2655
2	1449	0	0	1449	595	2044	0.7972	1629
3	1566	0	0	1566	595	2161	0.7118	1538
4	2309	540	162	2147	595	2742	0.6355	1742
5	2616	1620	486	2130	595	2725	0.5674	1546
6	2986	2700	810	2176	595	2771	0.5066	1403
7	3705	4320	1296	2409	595	3004	0.4523	1358
8	3947	6480	1944	2003	595	2598	0.4039	1049
9	4189	9180	2754	1435	595	2030	0.3606	732
10	4431	11880	3564	867	595	1462	0.3220	470
11	4673	15120	4536	137	595	732	0.2875	210
12	4915	18360	5508	-593	595	2	0.2567	1

TABLE A-5
TREE REPLACEMENT COST CALCULATION
ORCHARD CONDITION SURVEY
PEACHES

Year	Peach Cost	Peach Yd	Peach Rev	Net Rep Cost	Lost Net Rev	Total Cost	Discount Factors	PV Cost
1	2379	0	0	2379	615	2994	0.8929	2673
2	1587	2500	655	932	615	1547	0.7972	1233
3	1715	3240	848	866	615	1481	0.7118	1054
4	2529	7020	1839	689	615	1304	0.6355	829
5	2865	10260	2688	176	615	791	0.5674	449
6	3271	14040	3678	-407	615	207	0.5066	105

TABLE A-6
TREE REPLACEMENT COST CALCULATION
ORCHARD CONDITION SURVEY
APRICOTS

Year	Apricot Cost	Apricot Yd	Apricot Rev	Net Rep Cost	Lost Net Rev	Total Cost	Discount Factors	PV Cost
1	2379	0	0	2379	425	2804	0.8929	2503
2	1530	0	0	1530	425	1955	0.7972	1558
3	1654	540	108	1546	425	1971	0.7118	1402
4	2439	1620	324	2115	425	2540	0.6355	1614
5	2763	3240	648	2115	425	2540	0.5674	1441
6	3153	6480	1296	1857	425	2282	0.5066	1156
7	3913	10260	2052	1861	425	2286	0.4523	1033
8	4117	14580	2916	1201	425	1626	0.4039	656
9	4321	18900	3780	541	425	966	0.3606	348
10	4525	23220	4644	-119	425	306	0.3220	98

TABLE A-7
TREE REPLACEMENT COST CALCULATION
ORCHARD CONDITION SURVEY
PLUMS AND PRUNES

Year	Pl & Pr Cost	Pl & Pr Yd	Pl & Pr Rev	Net Rep Cost	Lost Net Rev	Total Cost	Discount Factors	PV Cost
1	2379	0	0	2379	-275	2104	0.8929	1878
2	965	0	0	965	-275	690	0.7972	550
3	1043	540	73	969	-275	694	0.7118	494
4	1538	1620	221	1316	-275	1041	0.6355	661
5	1742	3240	443	1298	-275	1023	0.5674	580
6	1988	5940	813	1174	-275	899	0.5066	455
7	2467	8640	1183	1283	-275	1008	0.4523	456
8	2628	11340	1553	1074	-275	799	0.4039	322
9	2789	14040	1923	865	-275	590	0.3606	212
10	2950	16740	2293	656	-275	381	0.3220	122
11	3111	19440	2663	447	-275	172	0.2875	49
12	3272	22140	3033	238	-275	-36	0.2567	-9